1 Description of neutron simulation for "fake" photons

The equivalent of 40 million neutrons ($E > 10$ MeV) from the target was generated in GEANT3 with a collimator system and PR and CAL similar to the standard KOPIO GEANT3 Monte Carlo. Based on the neutron trajectory, they are split into three categories. At the Z position of the downstream end of the first collimator station, the remaining particles produced by each original neutron are stored and used as 'seeds' for a separate generation step. The parameters of neutron-induced showers from this second step are stored in three separate files. Care is taken to keep track of all showers produced by a single original neutron from the target.

The three files have neutron showers from 4311, 1824 and 804 original neutron events. The file with 4311 events must be weighted by a factor 10 to take into account the sampling used in the multi-step generation. The probability of a neutron from the target inducing shower(s) in the PR and CAL is

$$(4311 \times 10 + 1824 + 804)/40 \times 10^6 = 1.1434 \times 10^{-3} \tag{1}$$

According to TN059, section 6 from the 1999 proposal, Table 4, p.142 there are 1.66×10^{-6} neutrons/proton/μsr with $E > 10$ MeV. Assuming 100×10^{12} protons/spill, a 2.4 second spill, a 100×5 mrad^2 aspect ratio, a 25 MHz microbunch frequency, a spoiler reduction factor of 0.5 and a correction factor for a non-pointlike target of 0.85 gives

$$(1.66\times10^{-6} n/p/\mu\text{sr}\times100\times10^{12} p/\text{spill}\times500\mu\text{sr}\times0.5\times0.85)/(2.4s\times25\times10^6 s^{-1}) = 587.8 n/\mu\text{bunch}. \tag{2}$$

So the mean number of neutron events in the PR and CAL per microbunch is

$$1.1434 \times 10^{-3} \times 587.8 = 0.665 \tag{3}$$

2 Preliminary results for background from "fake" photons

200 million microbunches were generated with "fake" photons drawn from the neutron-induced and stopped muon showers. Two candidates passed the set of kinematic cuts that give $\sim$ 120 signal events for the standard KOPIO assumptions. Taken at face value, this implies a background rate from this process of 0.6 events per spill; however, note that

1. no cuts have been added to suppress this type of background,
2. vetoing was ignored, and
3. both accepted candidates were due to the same original neutron showers.

Since a single neutron from the target can induce multiple showers in the PR and CAL, it is important to maintain any correlations between the showers in the simulation. A new sample of neutrons events, ten times larger than the original sample, is currently being generated. It is not clear if any symmetries can be exploited to obtain the additional factors need to reliably estimate the rate from this backround